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Do sprat and sardine larvae in the German Bight suffer from starvation?

M. Holtappels*+, J. Alheit*, C. Clemmesen #, R. Hinrichs*, B. Huver #
*Baltic Sea Research Institute Warnemünde; Seestraße 15, D-18119 Rostock;
Leibniz Institute of Marine Science Kiel, Düsternbrooker Weg 20, D-24105 Kiel
+Tel. +49381 5197 275; E-mail: moritz.holtappels@ io-warnemuende.de

GLOBEC Germany

Fig. 1: Location of a tidal mixing front (red line, green dots: detection of front position) and the transect across the front in the German Bight in June 2003.

Introduction

Seasonal appearances of tidal mixing fronts (TMF) induce structures in the water column where physical and biological properties change within very small scales. Abundance, ingestion rates and condition of sprat and sardine larvae, sampled across a TMF in the German Bight (Fig. 1), are related to the larval prey field. The role of larval starvation for recruitment is discussed.

Results and discussion

A completely mixed water column at St.514 contrasts with a well stratified water column at St.521. Station 519 was laid into the frontal zone (Fig. 2). Very patchy distribution of sprat and sardine larvae and their potential prey were found to be associated with these distinct water bodies.

The mixed part of the frontal system showed the highest Chl.a concentration (Fig. 3) combined with peak values of larval abundance and average zooplankton densities (Fig.4). At the stratified part, high Chl.a concentrations were observed, especially in the bottom layer, but larval and zooplankton abundance were below average. Within the transition zone (St. 515+519), Chl. a concentration was comparatively low. There, zooplankton abundance peaked in the bottom layer, but was lowest at the surface. In contrast, larval abundance was high at the surface and low at the bottom.

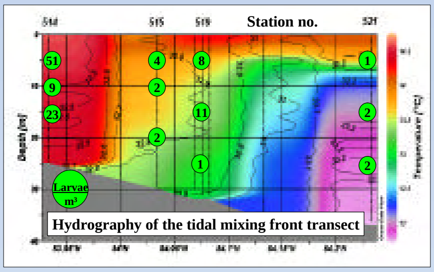


Fig. 2: Temperature (colour bar) and salinity (isolines) across the tidal mixing front (TMF). Green dots: No. of clupeid larvae collected in discrete depths.

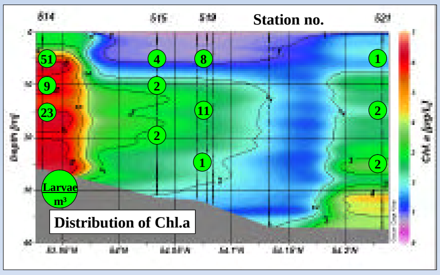


Fig. 3: Distribution of Chl.a derived from fluorescence measurements.

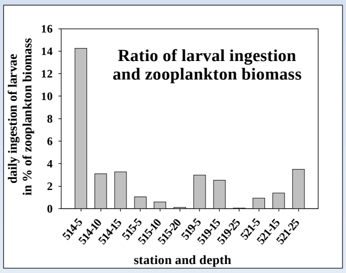


Fig. 5: Daily larval ingestion m^{-3} as percentage of the zooplankton biomass m^{-3} of the size class 30-400µm.

Larval ingestion/m³ varied considerably between 0.03 and 1.25mg m^{-3} d^{-1} (data not show here). Assuming that larvae exclusively feed on zooplankton of the size class 30 to 400µm, the portion of standing stock ingested by larvae mainly varied between 0.1 and 3.3% day^{-1}, but is extremely high (14% day^{-1}) at the surface of St.514 (Fig. 5).

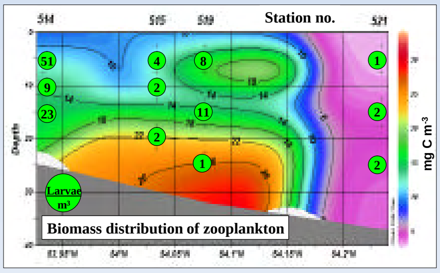


Fig. 4: Biomass distribution of zooplankton of the size class 30 to 400µm across the TMF. The major fraction is due to nauplii, bivalvia and pluteus larvae.

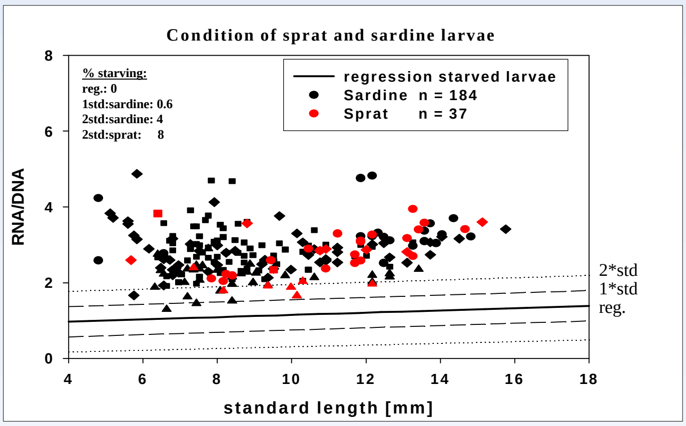
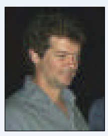


Fig. 6: RNA-DNA ratio of sprat and sardine larvae compared to values of laboratory starved herring larvae. ■ Station 514, ▲ Station 515, ◆ Station 519, ● Station 521
Lowest values were found at St.515, highest values were found at St.521 and 514.

Condition of both, sprat and sardine larvae, is found to be well above the level of starvation (Fig. 6). RNA-DNA ratio was high at the surface of St.514 indicating that, despite the large quantity of larvae, sufficient food was still available at this sampling site.

Distribution of clupeid larvae and their potential prey was patchy across the frontal system. Although larvae were found in different water bodies, which contrasted strongly in their prey concentration, no starving larvae were found. Larval mortality due to starvation seems to play a minor role. Mortality due to predation on the other hand can be extremely high and heavy predation on clupeid larvae in the German Bight was frequently reported (personal comment: M. Bernreuther).



M. Holtappels